

### **REMARKS**

1. Claim 19 has been amended to recite "A catalyst comprising silver, rhenium and a rhenium copromoter selected from tungsten, molybdenum, chromium, sulfur, phosphorus, boron, and compounds thereof . . . and wherein the catalyst further comprises the rhenium copromoter in a quantity of at least 0.1 mmole/kg, based on the total of the elements, relative to the weight of the catalyst." This amendment is based on original claims 11 and 29 as well as page 11, lines 5-15 of the application text. Claims 29 and 30 have been amended to provide consistency with amended Claim 19. Claims 20-30 have been amended to correct claim dependencies. The catalyst independent claim is not claim 17 but instead claim 19.

2. Claims 1-29 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. The Examiner states: "the phrase '...while the organic halide is present in a relative quantity Q which is maintained constant, which relative quantity Q is the ratio of an effective molar quantity of active halogen species present in the feed to an effective molar quantity of hydrocarbons present in the feed' in the claims is a relative phrase defined by itself which renders the claim indefinite." *Office Action*, dated September 21, 2005, page 2, 3rd paragraph. Applicants respectfully submit that the Examiner errs. The term "relative quantity Q" is not defined by itself. The term "relative quantity Q" is a ratio, in particular the ratio of an effective molar quantity of active halogen species present in the feed to an effective molar quantity of hydrocarbons present in the feed, as defined in claim 1. The effective molar quantity of active halogen species present in the feed may be calculated by multiplying the molar quantity of each of the organic halides

present in the feed with a factor, and adding up the multiplication products, wherein each factor represents the number of active halogen atoms present per molecule of the organic halide in question, except when the organic halide comprises a methyl compound, in which particular situation, the factor may be determined and verified by routine experimentation. *Application Text*, page 14, line 26 – page 15, line 32. The effective molar quantity of hydrocarbons present in the feed may be calculated by multiplying the molar quantity of each of the hydrocarbons present in the feed with a factor, and adding up the multiplication products, wherein the factor may be determined and verified by routine experimentation. The factor for ethylene is 1, by definition. *Application Text*, page 15, line 33 – page 16, line 31. Thus, the definition for the term “relative quantity Q” is not defined by itself and one of ordinary skill in the art would be apprised of the scope of the invention. Applicants respectfully request the rejection under 35 U.S.C. § 112, second paragraph, be withdrawn.

3. Claims 1-29 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lauritzen US 4,766,105 (hereinafter the ‘105 reference) taken with Lauritzen US 4,761,394 (hereinafter the ‘394 reference) in view of Evans WO 95/17957 (hereinafter the ‘957 reference). This rejection is respectfully traversed. The MPEP § 2143 states:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant’s disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

The present invention relates to epoxidation catalysts containing a relatively small quantity of a rhenium component, as defined in the claims. It has been found that the catalysts of the present invention retain their selectivity better, such that after a certain period of use they outperform the catalysts which comprise more rhenium and accordingly have a longer service life. *Application Text*, page 4, lines 11-27.

The '105 reference teaches an epoxidation catalyst containing silver, alkali metal, rhenium and a rhenium copromoter selected from sulfur, molybdenum, tungsten, chromium and mixtures thereof. *U.S. Patent No. 4,766,105*, col. 1, l. 66 – col. 2, l. 6. The amounts of rhenium and rhenium copromoter present on the catalyst are generically disclosed as ranging from about 0.1 to about 10, more preferably from about 0.2 to about 5 mmoles per kilogram of total catalyst. *Id.* at col. 8, ll. 37-42; col. 11, ll. 16-20. The surface areas generically disclosed for the support are below about 10 m<sup>2</sup>/g and preferably below about 3 m<sup>2</sup>/g. *Id.* at col. 3, l. 37 – col. 4, l. 2. In the illustrative embodiments, the catalysts contain an amount of rhenium promoter in the range of from 0.5 to 4  $\mu$ moles/gram of catalyst and the surface areas of the carriers used to prepare the catalysts range from 0.21 to 2.06 m<sup>2</sup>/g. Experiment No. 5-2 discloses a silver-based catalyst containing 0.5 mmole of rhenium per kilogram of total catalyst on a support having a surface area of 0.42 m<sup>2</sup>/g. *Id.* at col. 21, l. 51 – col. 22, l. 4; Table 5. During the testing of the catalysts, the reactor feed contained 30 % ethylene, 8.5 % oxygen, 7 % CO<sub>2</sub>, 54.5 % nitrogen, and 4.4 to 5.6 ppmv vinyl chloride. *Id.* at col. 20, ll. 26-30.

The '394 reference teaches an epoxidation catalyst containing silver, alkali metal, and rhenium. *U.S. Patent No. 4,761,394*, col. 1, l. 66 – col. 2, l. 4. The '394 reference has similar disclosures as the '105 reference. The amount of rhenium present on the catalyst is generically disclosed as ranging from about 0.1 to about 10,

more preferably from about 0.2 to about 5 mmoles per kilogram of total catalyst. *Id.* at col. 8, ll. 5-10. The surface areas generically disclosed for the support are below about 10 m<sup>2</sup>/g and preferably below about 3 m<sup>2</sup>/g. *Id.* at col. 3, ll. 52-57. In the illustrative embodiments, the catalysts contain an amount of rhenium promoter in the range of from 0.5 to 4  $\mu$ moles/gram of catalyst and the surface areas of the carriers used to prepare the catalysts range from 0.21 to 0.48 m<sup>2</sup>/g. Experiment No. 5-2 discloses a silver-based catalyst containing 0.5 mmole of rhenium per kilogram of total catalyst on a support having a surface area of 0.42 m<sup>2</sup>/g. *Id.* at col. 19, ll. 28-35; Table 5. During the testing of the catalysts, the reactor feed contained 30 % ethylene, 8.5 % oxygen, 7 % CO<sub>2</sub>, 54.5 % nitrogen, and 4.4 to 5.6 ppmv vinyl chloride. *Id.* at col. 18, ll. 3-7.

The '957 reference teaches the addition of group IVB oxo salts to a silver based ethylene oxide catalyst, having a promoting amount of alkali metal and promoting amount of rhenium. *PCT International Application Publication No. WO95/17957*, page 2, lines 23-28. In describing the state of the art, the '957 reference discloses gradually increasing the reactor temperature as the catalyst activity declines. *Id.* at page 1, lines 23-25. The surface areas generically disclosed for the support range from 0.05 to 10 m<sup>2</sup>/g and preferably below 3 m<sup>2</sup>/g. *Id.* at page 3, lines 32-35. The amount of rhenium present on the catalyst is generically disclosed as between 0.1 to 10, more preferably between 0.2 to 5  $\mu$ moles (rhenium element) per gram of total catalyst. *Id.* at page 8, lines 4-7. The '957 reference discloses the optional presence of rhenium copromoters selected from sulfur, chromium, molybdenum, tungsten and mixtures thereof. *Id.* at page 3, lines 1-4; page 7, lines 17-35. In the illustrative embodiments, the catalysts contain an amount of rhenium promoter in the range of from 1.2 to 1.5  $\mu$ moles/gram of catalyst and the surface areas

of the carriers used to prepare the catalysts range from 0.48 to 1.01 m<sup>2</sup>/g. In Illustrative Embodiment 3, catalysts A-6 and SA-6 contained 1.5 mmole of rhenium and 1.5 mmole of sulfate per kilogram of catalyst and were prepared using a carrier having a surface area of 1.01 m<sup>2</sup>/g. During the testing of the catalysts, the reactor feed contained 30 % ethylene, 8.5 % oxygen, 5 % CO<sub>2</sub>, 0.5 % argon, balance nitrogen, and 0.5 to 5 ppmv ethyl chloride. *Id.* at page 19, lines 28-31.

Neither the '105 reference, the '394 reference nor the '957 reference teaches or suggests a process for the epoxidation of an olefin utilizing a catalyst comprising rhenium in a quantity of at most 1.5 mmole/kg, relative to the weight of the catalyst, and at most 0.0015 mmole/m<sup>2</sup>, relative to the surface area of the carrier, in which process the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst while the organic halide is present in a relative quantity Q which relative quantity Q is maintained constant.

The '105 reference and the '394 reference are silent with respect to increasing the reaction temperature to reduce the effect of loss of activity while the organic halide is present in a relative quantity Q which relative quantity Q is maintained constant. In discussing the state of the art, the '957 reference discloses gradually increasing the reactor temperature as the catalyst activity decreases. However, the '957 reference is silent with respect to maintaining the relative quantity Q constant when the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst.

Therefore, there is no suggestion or motivation to modify or combine the '105, '394 and '957 references to arrive at the process of the present invention.

Also, neither the '105 reference, the '394 reference nor the '957 reference teaches or suggests a catalyst comprising silver, rhenium in a quantity of at most 0.9

mmole/kg, relative to the weight of the catalyst, and at most 0.0015 mmole/m<sup>2</sup>, relative to the surface area of the carrier, and a rhenium copromoter selected from tungsten, molybdenum, chromium, sulfur, phosphorus, boron, and compounds thereof in a quantity of at least 0.1 mmole/kg, based on the total of the elements, relative to the weight of the catalyst. In the illustrative embodiments, Table 5, present in both the '105 and '394 references, teaches away from using catalysts with at most 0.9 mmole of rhenium per kilogram of catalyst. Experiments 5-1 through 5-7 teach the best catalyst performance occurs when using rhenium in a quantity between 2 to 3  $\mu$ moles per gram of catalyst. Further, in the '105, '394 and '957 references, there is no teaching with respect to the amount of rhenium that should be present on the catalyst relative to the surface area of the carrier.

Therefore, there is no suggestion or motivation to modify or combine the '105, '394 and '957 references to arrive at the catalyst of the present invention.

Additionally, one of ordinary skill in the art would not have had a reasonable expectation of success in modifying the '105 reference as suggested by the Examiner. As discussed hereinbefore, the '105 and '394 references do not teach or suggest increasing the reaction temperature to reduce the effect of loss of activity or maintaining the relative quantity Q constant when the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst. The '957 reference is completely silent with respect to maintaining the relative quantity Q constant when the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst. Further, there is no suggestion or expressed expectation of success in the '105, '394 or '957 references to improve catalytic performance by using a process as defined in the present invention. Therefore, when

modifying or combining the '105, '394 and '957 references, there is no reasonable expectation of success in arriving at the process of the present invention.

As discussed hereinbefore, the '105 and '394 references teach away from using catalysts with at most 0.9 mmole of rhenium per kilogram of catalyst. Further, in the '105, '394 and '957 references, there is no teaching with respect to the amount of rhenium that should be present on the catalyst relative to the surface area of the carrier. Therefore, when modifying or combining the '105, '394 and '957 references, there is no reasonable expectation of success in arriving at the catalyst of the present invention.

Further, the '105, '394 and '957 references do not teach or suggest all the claim limitations. The references do not teach or suggest all the features of a process for the epoxidation of an olefin, which process comprises reacting a feed comprising an olefin, oxygen and an organic halide, in the presence of a catalyst comprising silver and rhenium deposited on a carrier, wherein the catalyst comprises rhenium in a quantity of at most 1.5 mmole/kg, relative to the weight of the catalyst, and at most 0.0015 mmole/m<sup>2</sup>, relative to the surface area of the carrier, and in which process the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst while the organic halide is present in a relative quantity Q which is maintained constant, which relative quantity Q is the ratio of an effective molar quantity of active halogen species present in the feed to an effective molar quantity of hydrocarbons present in the feed. Also, the references do not teach or suggest all the features of a catalyst comprising silver, rhenium and a rhenium copromoter selected from tungsten, molybdenum, chromium, sulfur, phosphorus, boron, and compounds thereof deposited on a carrier, wherein the catalyst comprises rhenium in a quantity of at most 0.9 mmole/kg, relative to the weight of the catalyst, and at most

0.0015 mmole/m<sup>2</sup>, relative to the surface area of the carrier, and wherein the catalyst further comprises the rhenium copromoter in a quantity of at least 0.1 mmole/kg, based on the total of the elements, relative to the weight of the catalyst.

In view of these arguments, the three criteria for establishing a *prima facie* basis for obviousness have not been met. Applicant respectfully requests that the rejection be withdrawn.

### CONCLUSION

The rejections having been traversed, allowance of the claims of the present application is respectfully requested. If the Examiner would like to discuss this case with Applicants' attorney, the Examiner is invited to contact Richard Lemuth at the phone number below.

Respectfully submitted,  
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